Remarks

The Office Action dated November 6, 2006 has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1, 3-7, 9-10, and 20-22 are pending in this application. Claims 1-22 stand rejected. Claims 2, 8, and 11-19 have been cancelled.

The objection to the drawings under 37 CFR 1.8(p)(5) is respectfully traversed.

A replacement sheet of drawings containing amended Figure 3 is submitted herewith for approval. Figure 3 has been amended to show main coolant flow channel coolant inlet 90.

The rejection of Claims 1-22 under 35 U.S.C. § 112, second paragraph, is respectfully traversed.

Claim 1 has been amended to recite "said main coolant flow channel extending from said coolant inlet through said fuel support and said lower tie plate into fuel bundle main body ". Applicants submit that claim 1 is definite and particularly points out and distinctly claims the subject matter which Applicants regard as their invention. Accordingly, Applicants submit that Claims 1, 3-7, 9-10, and 20-22 meet the requirements of Section 112, second paragraph. Claims 2, 8, and 11-19 have been cancelled.

For the reasons set forth above, Applicants respectfully request that the Section 112, second paragraph, rejection of Claim 1-22 be withdrawn.

The rejection of Claims 1-7 and 13-16 under 35 U.S.C. § 102(b) as being anticipated over Church (US 5,198,185) is respectfully traversed.

Church describes a nuclear reactor core that includes a plurality of fuel assemblies that have an upper portion that is located inside a plenum. A universal sleeve housing extends

around the fuel element. An upper portion of the housing is positioned in the plenum and the lower portion surrounds the fuel element below the plenum. An orifice having a plurality of holes is positioned between the fuel element and the plenum. Church describes at Col. 1, lines 63-66, that "[e]ach position in the core may have a different orifice plate. The different plates have different numbers and arrangements of holes so that the flow of in each position may vary." Church does not describe a plurality of coolant orifices and a plurality of restriction devices, with each coolant orifice located in the inlet of the main coolant flow channel of one of the plurality of fuel assemblies and each restriction device detachably coupled to a lower end of said tie plate where the coolant orifices and the restriction devices located in a particular region of the core are configured so that a flow of coolant through the main coolant flow channels of the fuel assemblies located in the particular region are substantially the same.

Independent Claim 1 of the present application recites "[a] nuclear reactor core comprising: a plurality of fuel assemblies, each said fuel assembly comprising a fuel bundle, a lower tie plate coupled to a lower end of said fuel bundle, a fuel support coupled to said lower tie plate, and a main coolant flow channel comprising an inlet, said main coolant flow channel extending from said coolant inlet through said fuel support and said lower tie plate into fuel bundle main body; and a coolant flowing through said plurality of fuel assemblies; said plurality of fuel assemblies arranged into at least three regions within said core; each said main coolant flow channel further comprising a means of controlling a flow of coolant through said main coolant flow channel so that the flow of coolant through said main coolant flow channels of said fuel assemblies located in a particular region are substantially the same, and that the coolant flow through said fuel assemblies in each said region is different from the coolant flow through said

fuel assemblies in each other region, said means of controlling said flow of coolant through said main coolant flow channel comprising a plurality of coolant orifices and a plurality of restriction devices, each said coolant orifices located in said inlet of said main coolant flow channel, each said restriction device detachably coupled to a lower end of said lower tie plate, each said main coolant flow channel having its own means of controlling coolant flow that is separate from means of controlling coolant flow for each other main coolant flow channel."

Church does not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Church does not describe nor suggest a core having a plurality of fuel assemblies with each having a main coolant flow channel that includes a means of controlling a flow of coolant through the main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, with the means comprising a plurality of coolant orifices and a plurality of restriction devices. Specifically, Church does not describe nor suggest a fuel assembly that includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate. Rather, Church teaches at Col. 1, lines 63-66, that "[e]ach position in the core may have a different orifice plate. The different plates have different numbers and arrangements of holes so that the flow of in each position may vary." Further, Church describes, at Col. 2, lines 53-55 that his invention does not include an orifice plate located in the fuel assembly. Accordingly, Applicants submit that Claim 1 is patentable over Church.

Claims 2 and 13-16 have been canceled.

Claims 3-7 depend from independent Claim 1. When the recitations of dependent Claims 3-7 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 3-7 likewise are patentable over Church.

For the reasons set forth above, Applicants respectfully request that the Section 102(b) rejection of Claims 1-7 and 13-16 be withdrawn.

The rejection of Claims 1-22 under 35 U.S.C. § 102(b) as being anticipated over Congdon et al. (US 5,149,491) is respectfully traversed.

Congdon et al. describe a nuclear reactor core arrangement that includes mounting fuel bundles on orificed support stubs mounted on the core support. As described in Col. 4, lines 26-43, the fuel bundles are divided into three groups, a group of fresh bundles, a group of bundles at mid-life, and a group of bundles near the end of their useful life. The orificed support stubs are likewise divided into three groups, small-orificed stubs, large-orificed stubs, and peripheral stubs, which also have small orifices. The small-orificed stubs and the peripheral stubs define 1 inch apertures through the core support plate, while the large-orificed stubs define 2" apertures through the core support plate.

Congdon et al. do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Congdon et al. do not describe nor suggest a each main coolant flow channel of fuel assembly includes a means of controlling a flow of coolant through the main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region. Also, Congdon et al. do not describe nor suggest a fuel assembly that includes

a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate. Rather, Congdon et al. describe multiple regions that include various sized orificed stubs to control the flow of coolant through the fuel assemblies. Congdon et al. describe in Col. 5, lines 16-19, that "an attachment could narrow the otherwise large orifice of a stub to provide smaller-orificed stubs." However, Congdon et al. do not describe nor suggest a restriction device detachably coupled to the lower tie plate in addition to the orificed-stub. Accordingly, Applicants submit that Claim 1 is patentable over Congdon et al.

Claims 2, 8, and 11-19 have been cancelled

Claims 3-7, 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 3-7, 9-10, and 20-22 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 3-7, 9-10, and 20-22 likewise are patentable over Congdon et al.

For the reasons set forth above, Applicants respectfully request that the Section 102(b) rejection of Claims 1-22 be withdrawn.

The rejection of Claims 1-22 under 35 U.S.C. § 103(a) as being unpatentable over Patterson (US 3,892,625) in view of Yasuyaki (JP 06-289178) is respectfully traversed.

Applicants submit that the Section 103 rejection of the pending claims is not proper because a *prima facie* case of obviousness has not been established. Particularly, and as explained below, the combination of the teachings of Patterson and the teachings of Yasuyaki do not describe nor teach all the recited limitations in Claim 1 of the present application.

Patterson does not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Patterson does not describe nor suggest that the plurality of fuel assemblies are

arranged into at least three regions within the core. Rather, Patterson describes that the fuel assemblies are arranged into two regions in the core. Specifically, at Col. 3, lines 20-25, Patterson, referring to Figure 1, describes that "[i]n the region located outside line A are the restraint assemblies 18 and reflector assemblies, whereas in the region located between lines A and B are located the radial blanket fuel assemblies or breeder assemblies, and in the region inside line B are located the fuel assemblies". Applicants submit that restraint assemblies 18 are not fuel assemblies, but rather flow control devices to control the flow of coolant to a number of fuel assemblies. Further, the Office Action dated October 15, 2004, at page 3 admits that Patterson does not teach three core flow regions.

Further, Patterson et al. do not describe nor suggest a fuel assembly that includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate, with the main coolant flow channel extending from the coolant inlet through the fuel support and the lower tie plate into the fuel bundle main body. Rather, Patterson describes that flow of coolant through several blanket fuel assemblies are controlled by one restraint assembly (a flow control device), see Figure 2. The main coolant flow channel of each blanket fuel assembly does not include its own separate means of controlling the coolant flow through the channel located in the inlet of the main coolant flow channel where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

Yasuyaki is cited for teaching three flow rate regions. Yasuyaki is not cited for, and does not teach that main coolant flow channel of each fuel assembly has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main

coolant flow channel and that each fuel assembly includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Rather, as best understood from the English language abstract, Yasuyaki describes tripartite flow rate regions of a reactor core. The cooling material is pumped by a single electromagnetic pump through the core. Yasuyaki describes that each flow rate in the regions 2-4 is adjusted to an optimum state. However, Yasuyaki does not describe nor suggest that each fuel assembly includes a main coolant flow channel and a separate means of controlling a flow of coolant through the main coolant flow channel where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Yasuyaki only describes a pump for controlling the coolant flow through regions 2-4.

Patterson and Yasuyaki, alone or in combination, do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Patterson and Yasuyaki, alone or in combination, do not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. As explained above, Patterson does not describe nor suggest that each fuel

assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes a separate means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly, and Yasuyaki does not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes a separate means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Combining the teachings of Patterson and Yasuyaki does not provide or suggest a reactor core where each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel includes its own means of controlling a flow of coolant through the main coolant flow channel that is located in the inlet of the main coolant flow channel, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Therefore combining the teachings of Yasuyaki with the teachings of Patterson does not describe nor suggest all the limitations of Claim 1. Accordingly, Applicants submit that independent Claim 1 is patentable over Patterson and Yasuyaki, alone or in combination.

Claims 2, 8, and 11-19 have been cancelled

Claims 3-7, 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 3-7, 9-10, and 20-22 are considered in combination with the recitations of

Claim 1, Applicants respectfully submit that Claims 3-7, 9-10, and 20-22 likewise are patentable over Patterson and Yasuyaki, alone or in combination.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 1-22 be withdrawn.

The rejection of Claims 8-12 and 17-22 under 35 U.S.C. § 103(a) as being unpatentable over the Background Of The Invention of the present application in view of Church is respectfully traversed.

The Background Of The Invention describes at paragraph [0008] that

> Known BWRs include two orifice regions usually designated as peripheral and center. The peripheral region includes all fuel locations around the periphery of the core, and the center region includes the remainder of the locations. The inlet orifice design limits the peripheral region flow per fuel element to about half of the flow per fuel element of the center region. Limiting the peripheral flow by this magnitude permits the very low power peripheral fuel elements to saturate the coolant flow, but the exit quality and average voids are still much lower than for the other higher power region. This uneven exit quality and average void can produce inefficient steam separation and nuclear moderation.

Applicants submit that the Background Of The Invention of the present application does not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

There is no description or suggestion in the Background Of The Invention that the means of controlling coolant flow in a region permits the coolant flow to be substantially the same through each fuel assembly in the region where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

Further, as explained above, Church does not describe nor suggest a core having a plurality of fuel assemblies with each having a main coolant flow channel that includes a means of controlling a flow of coolant through the main coolant flow channel so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, with the means comprising a plurality of coolant orifices and a plurality of restriction devices. Specifically, Church does not describe nor suggest a fuel assembly that includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate. Rather, Church teaches at Col. 1, lines 63-66, that "[e]ach position in the core may have a different orifice plate. The different plates have different numbers and arrangements of holes so that the flow of in each position may vary." Further, Church describes, at Col. 2, lines 53-55 that his invention does not include an orifice plate located in the fuel assembly.

Applicants submit that combining the teachings of the Background Of The Invention with Church does not describe nor suggest a reactor core as recited in Claim 1. Particularly, and as explained above, the Background Of The Invention and Church, alone or in combination, do not describe nor suggest a fuel assembly in the core includes a main coolant flow channel and that

each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly.

Therefore, Applicants submit that a *prima facie* case of obviousness has not been established because the combination of the teachings of he Background Of The Invention and Church do not describe nor suggest all the limitations recited in independent Claim 1 of the present application. Accordingly, Applicants submit that Claim 1 is patentable over the Background Of The Invention and Church, alone or in combination.

Claims 8, 11-12, and 17-19 have been cancelled

Claims 9-10, and 20-22 depend from independent Claim 1. When the recitations of dependent Claims 9-10, and 20-22 are considered in combination with the recitations of Claim 1, Applicants respectfully submit that Claims 9-10, and 20-22 likewise are patentable over Background Of The Invention and Church, alone or in combination.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 8-12 and 17-22 be withdrawn.

The rejection of Claims 1, 2, and 13 under 35 U.S.C. § 103(a) as being unpatentable over Baxi (US 4,303,474) in view of Yasuyaki (JP 06-289178) is respectfully traversed.

Applicants submit that the Section 103 rejection of the pending claims is not proper because a *prima facie* case of obviousness has not been established. Particularly, and as explained below, the combination of the teachings of Baxi and the teachings of Yasuyaki do not describe nor teach all the recited limitations in the claims of the present application.

Baxi does not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Baxi does not describe nor suggest that the plurality of fuel assemblies are arranged into at least three regions within the core. Rather, Baxi describes that the fuel assemblies are arranged into two regions in the core, a region of blanket elements and a region of fuel elements. Specifically, at Col. 3, lines 9-15, Baxi , referring to Figure 1, describes that the core includes a plurality of fuel elements and a plurality of blanket elements. "The blanket elements are arranged in three rows around the fuel elements, and the core assembly assumes a hexagonal shape". Also, Baxi does not describe nor suggest a fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Rather, Baxi describes that the blanket elements include a flow restrictor device in the main coolant conduit. However, Baxi does not describe nor suggest that the main coolant conduit of the fuel elements include a means of controlling the flow through the conduit

so that the flow through each main coolant conduit of the fuel elements are substantially the same, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Applicants submit that there is no teaching in Baxi that the coolant flow through the main coolant conduit of each of the blanket elements (which make up one region in the core) are the same and that the coolant flow through the main coolant conduit of each of the other fuel elements (which make up the second region of the core) are substantially the same.

As explained above, Yasuyaki is cited for teaching three flow rate regions. Yasuyaki is not cited for, and does not teach that main coolant flow channel of each fuel assembly has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel and that each fuel assembly includes a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Rather, as best understood from the English language abstract, Yasuyaki describes tripartite flow rate regions of a reactor core. The cooling material is pumped by a single electromagnetic pump through the core. Yasuyaki describes that each flow rate in the regions 2-4 is adjusted to an optimum state. However, Yasuyaki does not describe nor suggest that each fuel assembly includes a main coolant flow channel and a separate means of controlling a flow of coolant through the main coolant flow channel where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Yasuyaki only describes a pump for controlling the coolant flow through regions 2-4.

Baxi and Yasuyaki, alone or in combination, do not describe nor suggest a nuclear reactor core as recited in Claim 1. Particularly, Baxi and Yasuyaki, alone or in combination, do not describe nor suggest that each fuel assembly in the core includes a main coolant flow channel and that each main coolant flow channel has its own means of controlling coolant flow that is separate from the means of controlling coolant flow for each other main coolant flow channel, so that the flow of coolant through the main coolant flow channels of the fuel assemblies located in a particular region are substantially the same, and that the coolant flow through the fuel assemblies in each region is different from the coolant flow through the fuel assemblies in each other region, where the means comprises a coolant orifice located in the coolant inlet and a restriction device detachably coupled to a lower end of the lower tie plate of the fuel assembly. Therefore combining the teachings of Yasuyaki with the teachings of Baxi does not describe nor suggest all the limitations of Claim 1. Accordingly, Applicants submit that independent Claim 1 is patentable over Baxi and Yasuyaki, alone or in combination.

Claims 2 and 13 have been canceled.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 1, 2, and 13 be withdrawn.

The rejection of Claims 1, 2, 13, and 18 under 35 U.S.C. § 102(a) as being unpatentable over Johansson et al. (DE 3150477A1) in view of Nakamura et al. (US 5,106,575) is respectfully traversed.

Independent Claim 1 of the present application recites a nuclear reactor core that include a plurality of fuel assemblies that are arranged into three regions within the core. The Office Action dated 10/15/04, at page 6 admits that Johansson et al. do not describe three regions of fuel

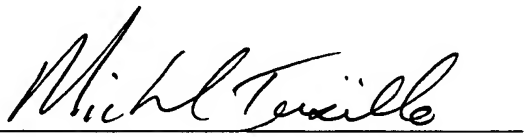
assemblies. Nakamura et al. is cited for teaching arranging nuclear cores with a plurality of coolant flow rates arranged in three zones and the Office Action dated 8/30/05, at page 6, directs Applicants to Figure 5, Col.4, lines 56-58, and Col. 6, lines 1-22. Applicants submit that Nakamura et al. teaches a nuclear fuel assembly that has varying flow rate through a single fuel assembly and does not describe a nuclear reactor core where the fuel assemblies are arranged into at least three regions. Specifically, Figure 5 shows an idealized velocity distribution of the coolant flow rate above and in the vicinity of the lower tie plate of a single fuel assembly (see Col. 5, lines 58-60. Also, Col.4, lines 56-58, and Col. 6, lines 1-22 describe means of controlling the coolant flow in different areas within a single fuel assembly. Applicants submit that a *prima facie* case of obviousness has not been established because the combination of the teachings of Johansson et al. and Nakamura et al. do not describe nor suggest all the limitations recited in Claim 1 of the present application. Specifically, Nakamura et al. only describe the various flow regions within a single fuel assembly and is silent as to coolant flow in different regions of the reactor core. Nakamura et al. does not describe a reactor core, only a single fuel assembly. Because Johansson et al. do not describe nor suggest three regions of fuel assemblies, as admitted in the Office Action dated 10/15/04, at page 6, and because Nakamura et al. do not describe a reactor core, only a single fuel assembly, and therefore, do not describe nor suggest a reactor core with three regions of fuel assemblies, Applicants submit that Johansson et al. and Nakamura et al., alone or in combination, do not describe nor suggest a nuclear reactor core as recited in Claim 1. Therefore, independent Claim 1 is patentable over Johansson et al. and Nakamura et al., alone or in combination.

Claims 2, 13, and 18 have been canceled.

For the reasons set forth above, Applicants respectfully request that the Section 103(a) rejection of Claims 1, 2, 13, and 18 be withdrawn.

In view of the foregoing amendments and remarks, all the claims now active in this application are believed to be in condition for allowance. Favorable action is respectfully solicited.

Respectfully submitted,



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